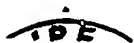


PATENT ABSTRACTS OF JAPAN



(11)Publication number : 2003-217642

(43)Date of publication of application : 31.07.2003

(51)Int.Cl.

H01M 8/06

H01M 4/92

H01M 8/10

H01M 8/24

(21)Application number : 2002-093982

(71)Applicant : UCHIDA ISAMU

(22)Date of filing : 29.03.2002

(72)Inventor : UCHIDA ISAMU
UMEDA MINORU
SUGII HIROMASA

(30)Priority

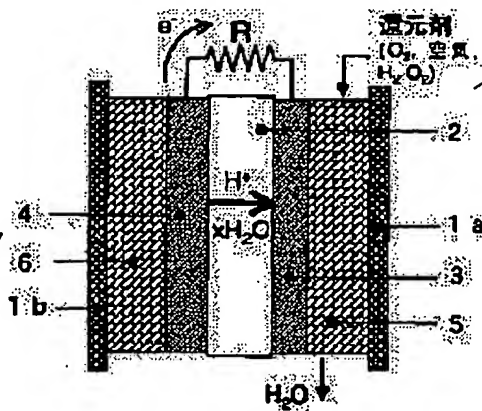
Priority number : 2001353034 Priority date : 19.11.2001 Priority country : JP

(54) DIRECT ALCOHOL FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell whose size and weight are securely reduced, having safety electromotive force and output property greater than a direct methanol fuel cell by using a specific electrode material for an anode with respect to a fuel cell of such a type as to directly feed isopropyl alcohol as a fuel to a fuel electrode.

SOLUTION: The miniaturized or microminiaturized fuel cell, having safety and electromotive force and output larger than a direct methanol fuel cell can be provided by using an isopropyl alcohol aqueous solution as the fuel and using a platinum - ruthenium alloy with a specific composition or an alloy material based on the alloy for the material of the anode.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

BEST AVAILABLE COPY

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-217642

(43)Date of publication of application : 31.07.2003

(51)Int.Cl.

H01M 8/06
H01M 4/92
H01M 8/10
H01M 8/24

(21)Application number : 2002-093982

(71)Applicant : UCHIDA ISAMU

(22)Date of filing : 29.03.2002

(72)Inventor : UCHIDA ISAMU

UMEDA MINORU

SUGII HIROMASA

(30)Priority

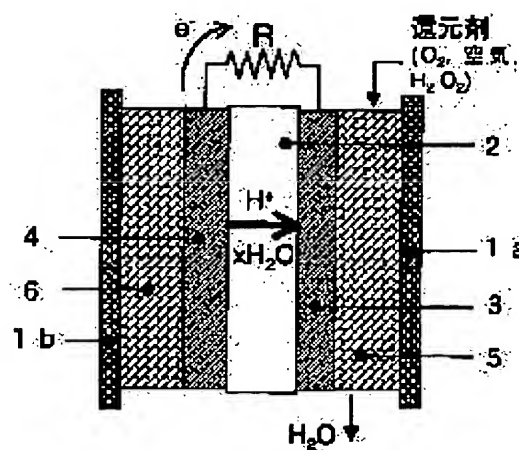
Priority number : 2001353034 Priority date : 19.11.2001 Priority country : JP

(54) DIRECT ALCOHOL FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell whose size and weight are securely reduced, having safety electromotive force and output property greater than a direct methanol fuel cell by using a specific electrode material for an anode with respect to a fuel cell of such a type as to directly feed isopropyl alcohol as a fuel to a fuel electrode.

SOLUTION: The miniaturized or microminiaturized fuel cell, having safety and electromotive force and output larger than a direct methanol fuel cell can be provided by using an isopropyl alcohol aqueous solution as the fuel and using a platinum - ruthenium alloy with a specific composition or an alloy material based on the alloy for the material of the anode.



LEGAL STATUS

[Date of request for examination]

29.03.2005

[Date of sending the examiner's decision of

rejection]

[Kind of final disposal of application other than the
examiner's decision of rejection or application
converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of
rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The direct alcoholic mold fuel cell characterized by being made as [supply / the fuel which becomes considering isopropyl alcohol as a principal component / in the fuel cell which consists of a case which holds these in the partial list which contains at least an anode, a cathode, the electrolyte by which mediation arrangement was carried out among these, and liquid fuel / to said anode / directly].

[Claim 2] The direct alcoholic mold fuel cell according to claim 1 with which said fuel is characterized by including isopropyl alcohol and water.

[Claim 3] The direct alcoholic mold fuel cell according to claim 1 or 2 with which said anode is characterized by constituting platinum or a platinum radical alloy as an active principle.

[Claim 4] The direct alcoholic mold fuel cell according to claim 3 with which said anode is characterized by constituting the platinum ruthenium alloy as an active principle.

[Claim 5] A direct alcoholic mold fuel cell given in claim 1 thru/or any of 4 they are. [which is characterized by the part which contains said liquid fuel becoming said case from a removable container]

[Claim 6] Said case is a direct alcoholic mold fuel cell according to claim 1 to 5 with which the volume is characterized by 100cm being three or less.

[Claim 7] It is a direct alcoholic mold fuel cell given in claim 1 thru/or any of 6 they are. [which is arranged so that said cathode in each cel may turn to the method of outside, while being arranged so that said anode / in / it has two or more cels while having further the supply way which supplies said fuel held in the part which contains said liquid fuel to said anode, and / in said cel / each cel / may carry out phase opposite across said supply way]

[Claim 8] The direct alcoholic mold fuel cell characterized by being made as [supply / the fuel which becomes said anode heated from 40 degrees C to 100 degrees C by said heating means considering ethanol as a principal component in the fuel cell which consists of a case which holds these in an anode, a cathode, the electrolyte by which mediation arrangement was carried out among these, the part which contains liquid fuel, and the heating means list of said anode at least / directly].

[Claim 9] The direct alcoholic mold fuel cell according to claim 8 with which said anode is characterized by constituting the platinum ruthenium alloy as an active principle.

[Claim 10] The generation-of-electrical-energy approach characterized by supplying directly the fuel which becomes this anode in the fuel cell possessing the electrolyte by which mediation arrangement was carried out at least between an anode, a cathode, and these considering ethanol as a principal component to the bottom of the condition that this anode was heated from 40 degrees C to 100 degrees C.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] It is related with the direct alcoholic mold fuel cell suitable for small lightweight-ization characterized by this invention using the anode ingredient which is characterized by supplying to an anode the fuel which contains isopropyl alcohol (2-propanol) and ethanol as a principal component directly in detail about the fuel cell which supplies alcohol fuel to a direct anode, and carries out anodic oxidation of this fuel effectively further.

[0002]

[Description of the Prior Art] A direct methanol mold fuel cell (DMFC) is a power plant comparatively operated at low temperature (ordinary temperature -120 degree C). Since this fuel cell supplies a methanol fuel to a direct anode as it inquires more in ancient times, the reforming machine for taking out hydrogen from alcohol becomes unnecessary, equipment itself does not appear in a miniaturization row as much as possible cheaply, and it can also simplify the whole operation means. Thus, although it is a direct methanol mold fuel cell with many advantages, the anodic oxidation reaction of a methanol has the fault of having a big overvoltage. By the oxygen-hydrogen fuel cell which uses hydrogen for a fuel, although it was large in the oxidation rate of hydrogen and the oxygen reduction in an air pole (oxygen pole) was rate-limiting, in a direct methanol mold fuel cell, methanol oxidation was not able to become far rate-limiting from oxygen reduction, and evasion of loss of power was not able to be escaped. Moreover, the toxicity which a methanol has also threatens the risk of about [injuring the health of the body], or a life. Furthermore, in the direct methanol mold fuel cell, it is known that a formic acid and formaldehyde will generate as reaction intermediate of methanol oxidization, and toxicity is reported for both.

[0003] the case where liquid fuel uses hydrogen gas as a fuel on the other hand -- comparing -- the safety as a combustible, and a miniaturization -- it has a great hope from the easy field. Although the fuel cell which uses wood ether instead of a methanol fuel is proposed from such a viewpoint, the present condition is that the above output characteristics which use a methanol are not obtained. For this reason, though it was the fuel cell which supplies liquid fuel to a direct anode, it has the output characteristics exceeding a direct methanol mold fuel cell, and waited eagerly for development of a safe fuel cell.

[0004]

[Problem(s) to be Solved by the Invention] The electrode reaction of a fuel cell consists of an anode reaction and a cathode reaction. A cathode reaction is usually oxygen reduction, and since this is nonavoidable, it is required that an anode reaction should be a reaction (a reaction rate is large) quicker than this. That is, an anode reaction is wanted not to become rate-limiting [the whole]. Although this requirement is satisfied when using hydrogen as a fuel, it is as having mentioned above that the demand to the handling of a hydrogen fuel cell is complicated, and it is unsuitable for the personal application aiming at a small power source, especially the power source of a pocket device etc. Instead promising ** is carried out liquid fuel, and a methanol is raised to the first-in-a-roll candidate. However, when it is independently used besides mixing a methanol with water, the current value which can take out the overvoltage of anodic oxidation greatly is also less than hydrogen. In addition, although wood ether is raised to the major candidate, the present condition is not discovering the anodic oxidation property exceeding a methanol in practice. As for the reason oxidation of a methanol becomes rate-limiting, the carbon monoxide generated in the process in which electrode oxidation is received sticks to an electrode, and carrying out poisoning of the electrode catalysts including platinum is considered as the cause. In

order to solve this, development of various electrode catalysts has been considered. Although reducing CO poisoning was known when a Pt-Ru alloy was used especially, the fuel electrode reaction had still become rate-limiting also in this case as compared with oxygen reduction, though liquid fuel was used, the overvoltage of liquid fuel oxidation reaction was reduced, and it waited eagerly for development of the technique of raising the electromotive force and the output current consistency of a fuel cell.

[0005] As mentioned above, as stated, the fuel cell of the type which supplies liquid fuel to a direct anode is very useful as small [including the object for pocket devices], and a micro power source. Though liquid fuel is used in this invention in view of such a demand, it lets the technique of reducing the overvoltage of a reaction as compared with a methanol, and raising current density pass, and aims at offering the fuel cell which has the electromotive force exceeding a direct methanol mold fuel cell and an output.

[0006]

[Means for Solving the Problem] In order to attain said purpose, as a result of repeating examination wholeheartedly, when this invention persons used isopropyl alcohol (2-propanol) as a fuel also unexpectedly, they did the knowledge of the fuel cell which has high electromotive force and high power being obtained. Moreover, this invention persons are supplying this to the anode heated by predetermined temperature, using ethanol as a fuel, and did the knowledge of the fuel cell which has high electromotive force and high power being obtained.

[0007] Said purpose is attained by offering the direct alcoholic mold fuel cell characterized by making this invention as [supply / the fuel which becomes considering isopropyl alcohol as a principal component / in the fuel cell which is made based on said knowledge and consists of a case which holds these in the partial list which contains at least an anode, a cathode, the electrolyte by which mediation arrangement was carried out among these, and liquid fuel / to said anode / directly].

[0008] Moreover, this invention is set to the fuel cell which consists of a case which holds these in an anode, a cathode, the electrolyte by which mediation arrangement was carried out among these, the part which contains liquid fuel, and the heating means list of said anode at least. Said purpose is attained by offering the direct alcoholic mold fuel cell characterized by being made as [supply / the fuel which becomes said anode heated from 40 degrees C to 100 degrees C by said heating means considering ethanol as a principal component / directly].

[0009] Furthermore, said purpose is attained by offering the generation-of-electrical-energy approach characterized by this invention supplying directly the fuel which becomes this anode in the fuel cell possessing the electrolyte by which mediation arrangement was carried out at least between an anode, a cathode, and these considering ethanol as a principal component to the bottom of the condition that this anode was heated from 40 degrees C to 100 degrees C.

[0010] The alcohol "is supplied directly" in this specification is reformed neither in hydrogen gas nor other gas, but it means supplying a fuel cell in the condition as it is.

[0011]

[Embodiment of the Invention] Hereafter, this invention is explained based on the desirable operation gestalt, referring to a drawing. Drawing 1 is the conceptual diagram showing the single cellular structure of the direct alcoholic mold fuel cell of this invention, has ion exchange membrane 2, and the cathode 3 and anode 4 which pinch it in case 1a and 1b, and comes to provide the oxidizer passage 5 and the liquid fuel stowage 6 on those outsides.

[0012] Although an ion exchange membrane 2 can be used by any ionic conduction type of an anion or a cation, a proton conduction type thing is used suitably. As ion exchange membrane 2, all well-known ingredients including the poly membrane which makes a perfluoroalkyl sulfonic-acid polymer representation can be used.

[0013] A cathode 3 and an anode 4 are porosity carbon paper with which the predetermined catalyst was applied, respectively in many cases. Mediation arrangement of the electrolyte membrane 2 is carried out between a cathode 3 and an anode 4, and it pinches, or three persons are joined by the hotpress or cast film production, and the film-electrode structure (Membrane Electrode Assembly) is constituted. the water repellent represented by polytetrafluoroethylene if required for porosity carbon paper -- addition -- or a laminating can also be carried out.

[0014] The anode 4 consists of making ion exchange membrane 2 contact, after often mixing the carbon which supported platinum or a platinum radical alloy in many cases with an ionic conduction ingredient. A desirable

result is obtained with an ionic conduction ingredient being the same ingredient as ion exchange membrane 2. As an approach of making an anode 4 contacting ion exchange membrane 2, well-known approaches including a hotpress and cast film production can be used. Besides the carbon which supported platinum or a platinum radical alloy, well-known things, such as what supported noble metals or them (electrode catalyst), and a thing which calcinated an organometallic complex or it, can be used as an anode 4. Noble metals which are indicated by the U.S. Pat. No. 5759712 specification, noble-metals thin films, or those layered products can also be used as an anode 4. A result with good platinum or platinum radical alloy is given also in these ingredients.

[0015] It is desirable to use an alloy with a kind or two sorts or more of elements chosen from the group which consists of platinum, a ruthenium, iridium, an osmium, iron, nickel and gold, cobalt, palladium, a tungsten, molybdenum, and tin as a platinum radical alloy from the point that the fuel cell of high electromotive force and high power is obtained. If a platinum ruthenium alloy is especially used, very good electromotive force and output will be obtained. As for the element ratio (former: latter) of the platinum and the ruthenium in the platinum ruthenium alloy from this viewpoint, it is desirable 65:35 to 10:90 and that it is 60:40 to especially 20:80.

[0016] The cathode 3 also consists of making ion exchange membrane 2 contact, after often mixing the carbon which supported platinum in many cases with an ionic conduction ingredient. A desirable result is obtained with an ionic conduction ingredient being the same ingredient as ion exchange membrane 2. As an approach of making a cathode 3 contacting ion exchange membrane 2, well-known approaches including a hotpress and cast film production can be used. Besides the carbon which supported platinum, well-known things, such as what supported noble metals or them (electrode catalyst), and a thing which calcinated an organometallic complex or it, can be used as a cathode 3.

[0017] While the oxidizer installation hole (not shown) for introducing an oxidizer (in the cases of many air) up is prepared, it is prepared for discharging unreacted air and a product (in the cases of many water) caudad in a cathode 3 side an oxidizer discharge hole (not shown). In this case, compulsive inhalation of air and/or a compulsive exhaust air means may be attached. Moreover, the free convection hole of air may be prepared in case 1a.

[0018] The liquid fuel stowage 6 is established in the outside of an anode 4. Although the liquid fuel stowage 6 may be a part for containing alcohol fuel, it may be a circulation way with an external fuel stowage (not shown). Under the present circumstances, a fuel is agitated by a free convection and/or the forced convection. When a forced convection is required, a forced-convection means may be attached.

[0019] When the fuel directly supplied to an anode 4 contained isopropyl alcohol as a principal component, it became clear by examination of this invention persons that good cel electromotive force and a good output were obtained. Moreover, it also became clear that a crossover is effectively prevented as a fuel is the mixture of isopropyl alcohol and water, and still better good cel electromotive force and good output were obtained. As for the mole ratio (former: latter) of propyl alcohol and water, it is desirable 1:60 to 1:0.1 and that it is 1:7 to especially 1:0.5 from the point that the high power engine performance and the fuel cell of high electromotive force are obtained. Furthermore, also when a fuel contains the mixture of isopropyl alcohol and a methanol as a principal component, good cel electromotive force and a good output are obtained. In this case, as for the mole ratio (former: latter) of isopropyl alcohol and a methanol, it is desirable 10:0.5 to 1:9 and that it is 9:1 to especially 7:3 from the point that the fuel cell of the further high power engine performance is obtained.

[0020] Also in supplying directly the fuel which uses ethanol as a principal component to the anode 4 which replaced with isopropyl alcohol and was heated by predetermined temperature, using ethanol as a fuel, it became clear by examination of this invention persons that the fuel cell of high electromotive force and high power was obtained. Ethanol has been considered that an electrode reaction rate is very slow compared with a methanol. However, this invention persons are carrying out the temperature up of the anode to the temperature of the predetermined range, and it found out being obtained, a reaction rate, i.e., high current density, to the extent that it applies to methanol electrode oxidation. The electrode reaction of ethanol mixes water to ethanol, and is further promoted by controlling the mixed ratio and attaining optimization of an anode electrode material.

[0021] When ethanol is directly supplied to the bottom of the condition which heated 100 degrees C of anodes 4 from 40 degrees C from 45 degrees C to 90 degrees C especially, it is desirable from the fuel cell of high electromotive force and high power being obtained further. To use ethanol as a fuel, it is necessary to attach the

heating means (not shown) of an anode 4 in a case. As this heating means, well-known heating means, such as a resistance heating element, a PTC heating element, infrared radiation, high frequency, and the Bell Choi component, can be used, for example. Although a heating means may be arranged to which part which can heat an anode 4, it is desirable not to bar contact to an anode 4 and a fuel as much as possible. For example, a heating means may be arranged in the liquid fuel stowage 6, or the whole case may be heated. In addition, it is necessary to mainly heat an anode 4 with a heating means at the start-up time of a fuel cell. Since an anode 4 is heated by self-generation of heat which originates in a reaction in steady operation, it is not necessary to heat an anode 4 with a heating means.

[0022] Although ethanol may be independently used when using ethanol as a fuel, it is desirable to use as a fuel what used ethanol as the principal component and added other components from points, such as promotion of the electrode reaction of ethanol and prevention of a crossover. For example, what contains ethanol and water as a fuel can be used. As for the mole ratio (former: latter) of ethanol and water, it is desirable 1:60 to 1:2 and that it is 1:10 to especially 1:3 from the point that the fuel cell of high electromotive force and high power is obtained. It is desirable 1:9 to 9:1 and to set the mole ratio (former: latter) of ethanol and a methanol especially to 3:7 to 7:3 using what contains ethanol and a methanol as a fuel for the same reason.

[0023] If it is independent in ethanol or electrode oxidization is performed with water, it is thought that an acetic acid, an acetaldehyde, a carbon dioxide, etc. generate. Since the environmental load is small, as for these matter, it is advantageous to use ethanol as a fuel also from this point. On the other hand, if it is independent in a methanol or electrode oxidization is performed with water, it is known that a formic acid, formaldehyde, etc. will generate. Each of these matter has a bad influence on a living body. Since it does not have profit with a parenchyma top that six electrons of methanols oxidize completely and a product becomes only a carbon dioxide, if a methanol is used as a fuel, being somewhat accompanied by the environmental load will not be avoided.

[0024] although the conceptual diagram of the direct alcoholic mold fuel cell shown in drawing 1 expresses only the single cel -- this invention -- setting -- this single cel -- as it is -- you may use it -- two or more cels -- a serial -- and/or, parallel connection can be carried out and it can also consider as a mounting fuel cell. The conventional connection type which uses a bipolar plate may be used for the connection method of cels, and the flat-surface connection type of "2000 Fuel Cell Seminar Abstracts" and the 812-page publication from 791 may be used for it, for example. Of course, adoption of a connection type well-known in addition to this is also useful.

[0025] Drawing 2 is the mimetic diagram showing another operation gestalt of the direct alcoholic mold fuel cell of this invention. The fuel cell shown in drawing 2 is carrying out the configuration of a little thick flat rectangular parallelepiped. In the fuel cell, the fuel-supply way 6 into which this is divided up and down is formed. Moreover, the fuel cell has the storage space of the liquid fuel which consisted of cylinder-like containers 7. The container 7 is removable to a fuel cell. Stoma 7a is formed in the side face at the container 7. The fuel contained in the container 7 is supplied through stoma 7a. It is possible to carry out the closure of the stoma 7a by the predetermined closure means (not shown), before being equipped with a container 7 into a case, and to carry out seal hold of the fuel into a container 7. Stoma 7a is formed in the location which this stoma 7a opens for free passage with the above-mentioned fuel-supply way 6 when equipped with a container 7 in a fuel cell.

[0026] The fuel cell of this operation gestalt possesses two or more cels. The 1st cel group which becomes the fuel-supply way 6 bottom from four cels is arranged at the detail. On the other hand, the 2nd cel group which also becomes the fuel-supply way 6 bottom from four cels is arranged. Each of each cels consists of electrolyte membranes 2 by which mediation arrangement was carried out between an anode 4, a cathode 3, and these, and has been independent separately. The cel in each cel group is arranged at the plane, and connection is carried out to the serial. The cel of the 1st cel group and the cel of the 2nd cel group are arranged so that those anodes 4 may carry out phase opposite across the fuel-supply way 6. With this, the cel of the 1st cel group and the cel of the 2nd cel group are arranged so that those cathodes 3 may turn to the method of outside. By arranging a cel in this way, the miniaturization of a fuel cell becomes easy and it becomes what was suitable as a small power source, especially a power source of a pocket device. Moreover, since the container 7 which contained the fuel is removable, a supplement of a fuel is easy and the fuel cell of this invention becomes what was suitable as a power source of a pocket device also by this. In addition, to use the ethanol mentioned above as a fuel, it is

necessary to attach the heating means of an anode 4 in a case.

[0027] A fuel may perform fuel supply to the fuel-supply way 6 out of a container 7 in the state of a liquid, or it may be performed by the gaseous state. It is desirable to consist of a porous body which in the case of which sintered SiO₂, aluminum 2O₃, etc., for example, and was obtained from the point of smooth supply of a fuel, macromolecule fiber, macromolecule porous membrane, etc. To use macromolecule fiber and macromolecule porous membrane, not to deform, even if these touch a fuel is required.

[0028] In drawing 2, it is desirable to arrange the member which has fuel breaker ability from the point of preventing a fuel reaching a cathode 3 (a kind of crossover) between the cels which adjoin a longitudinal direction (not shown). For example, the attainment to the cathode 3 of a fuel can be intercepted by being filled up with inorganic oxides including the polymeric materials represented by polyethylene and polypropylene, and glass and oxidation aluminum between the adjoining cels.

[0029] The cathode 3 in the cel of each cel group has turned to the method of outside as above-mentioned. That is, the cathode 3 has countered with the case. Space is prepared between the cathode 3 and the case. Moreover, the air hole (not shown) which makes this space and the exterior open for free passage is prepared in the case. Therefore, in the space between a cathode 3 and a case, air circulates by the free convection. Oxygen is supplied to a cathode 3 by this. Forced-convection means, such as a fan, may be attached to the predetermined part of a case to control supply of the air to a cathode 3.

[0030] The fuel contained in the container 7 is consumed by oxidation reaction with an anode 4. In this case, depending on the class of fuel, oxidation reaction may be barred with reaction intermediate and/or a resultant. However, in this operation gestalt, these matter is removable from the system of reaction by easy actuation of exchanging a container 7. Therefore, a generation of electrical energy is easily continuable. In this case, since reaction intermediate and/or a resultant are included, the advantage that an environmental load is mitigable by collecting the whole container 7 is also in a container 7.

[0031] According to the fuel cell of this operation gestalt, a miniaturization becomes easy as mentioned above. Therefore, especially the fuel cell of this operation gestalt can make the volume into the thing of small volume called three or less [20cm] three or less [100cm]. Although this volume is so desirable that it is small, the minimum volume in which current attainment is possible becomes about [10cm] three.

[0032] This invention is not restricted to said operation gestalt. For example, the operation gestalt shown in drawing 1 and drawing 2 which were mentioned above is an example for explaining this invention, and using the well-known approach except illustrating about arrangement of each cel, an array, connection, etc. does not cause inconvenience at all.

[0033] Moreover, although high electromotive force and high power are obtained even if it does not heat an anode when isopropyl alcohol is used as a fuel, generating electricity under the condition which heated the anode does not interfere.

[0034]

[Example] Next, an example explains this invention to a detail. However, an example is for explaining this invention in detail, and it does not need to refuse that this invention does not receive any constraint according to these examples, either.

[0035] (An example 1 and examples 1-3 of a comparison) The welding machine was used for gold foil with a diameter of 6mm, the 0.2mm gold streak was welded, and it considered as the lead section. The platinum layer with a thickness of about 0.1 micrometers was prepared in both sides of this gold foil section by the spatter producing-film method. Isopropyl alcohol (example 1), ethanol (example 1 of a comparison), a methanol (example 2 of a comparison), and 1-propanol (example 3 of a comparison) were added, and it considered as sample liquid so that it might become the perchloric acid water solution of 1 convention in l. and 0.5 mols /. The operation pole and the platinum wire were used for the counter electrode, the normal hydrogen electrode was used for the reference pole for the golden electrode which prepared the aforementioned platinum layer, these electrodes were immersed in each sample liquid, and electrochemistry measurement was performed in ordinary temperature. A result is shown in drawing 3. The direction of isopropyl alcohol (example 1) has the large absolute value of a current, and it turns out that the potential to which a current begins to flow is in ***** , and the methanol (example 2 of a comparison) currently considered to be activity most in alcohol from the current-potential curve (cyclic voltamogram) of drawing 3 shows that it is the thing exceeding a methanol as a fuel. In addition, in the absolute value of a current, and the comparison of the potential to which a current

begins to flow, it is clear from the result of drawing 3 that 1-propanol's [ethanol (example 1 of a comparison) and] (example 3 of a comparison) the property exceeding a methanol is not shown.

[0036] (An example 2 and examples 4-6 of a comparison) It replaced with the electrode used in an example 1 and the examples 1-3 of a comparison, and the same measurement as an example 1 and the examples 1-3 of a comparison was performed except having used the electrode which prepared the platinum ruthenium alloy by the spatter on gold foil so that the element ratio of both metals might be set to 5:5. A result is shown in drawing 4. Although the rank of electrode oxidation of each alcohol is not different from the case (refer to drawing 3) of a platinum electrode, in the case of isopropyl alcohol (example 2) and a methanol (example 5 of a comparison), it is especially clearer than a platinum electrode its for the potential to which the absolute value of a current is [the platinum ruthenium alloy] larger, and a current begins to flow to also be known by to have shifted to **, and to act in favor of electrode oxidation of alcohol.

[0037] (They are the examples 7-9 of a comparison to an example 3 and 4 lists) Each alcohol shown in Table 1 to pure water was adjusted so that it might become in 1. and 0.5 mols /, and it supplied to the fuel electrode of a commercial fuel cell (model PEMPower1 made from H-TEC-DMFC). In addition, the cathode side of this fuel cell performs oxygen supply by the free convection of air. Moreover, the platinum ruthenium alloy with which platinum and a ruthenium are 1:1 by the element ratio is used for the anode. The open circuit voltage (electromotive force) of the fuel cell in the ordinary temperature at the time of using each fuel and the maximum output (current x electrical potential difference) at the time of taking out a current are shown in Table 1.

[0038]

[Table 1]

		燃料の種類	開路電圧 (V)	最大出力 (mW)
実施例	3	イソプロパノール	0.86	27
	4	イソプロパノール : メタノール = 1 : 1 (モル比)	0.8	30
比較例	7	メタノール	0.67	26
	8	エタノール	0.7	14
	9	1-プロパノール	0.52	7

[0039] As mentioned above, it turns out that it exceeds the direct alcoholic mold fuel cell using the mixed alcohol of isopropyl alcohol or isopropyl alcohol, and a methanol conventionally in the property which synthesized a circuit electrical potential difference and the maximum output for the fuel cell (DMFC) with which the methanol has been made best in liquid fuel. Furthermore, the aforementioned result showed that platinum and a platinum ruthenium alloy were also suitable as an anode pole ingredient.

[0040] (They are the examples 10 and 11 of a comparison to an example 5 and 6 lists) It heated to the temperature which shows an anode in Table 2 using the electrode and sample liquid which were used for the example 1 list in the examples 1-3 of a comparison, and the same current-potential curve as example -of comparison 3 was measured in the example 1 list. A measurement result is shown in Table 2.

[0041]

[Table 2]

		燃料	0.7Vにおける電流密度 (mA/cm ²)			
			アノード加熱温度			
			40℃	60℃	80℃	100℃
実施例	5	イソプロパノール	5.7	4.8	1.7	15
	6	エタノール	0.5	1	1.1	14
比較例	10	メタノール	0.7	1.2	1.3	16
	11	1-プロパノール	0.2	0.4	0.7	6.2

[0042] In an elevated temperature (40 degrees C or more), it is with ethanol and a methanol and it turns out that the value of almost equivalent current density is acquired so that clearly from contrast with the example 6 and the example 10 of a comparison in Table 2. Therefore, it turns out that ethanol becomes advantageous from the point of the safety of the matter produced according to anode electrode reaction rather than a methanol in operating a fuel cell at an elevated temperature.

[0043] (They are the examples 12 and 13 of a comparison to an example 7 and 8 lists) It heated to the temperature which shows an anode in Table 3 using the electrode and sample liquid which were used for the example 2 list in the examples 4-6 of a comparison, and the same current-potential curve as the examples 4-6 of a comparison was measured in the example 2 list. A measurement result is shown in Table 3.

[0044]

[Table 3]

		燃料	0.7Vにおける電流密度 (mA/cm ²)			
			アノード加熱温度			
			40℃	60℃	80℃	100℃
実施例	7	イソプロパノール	12	18	22	33
	8	エタノール	4.5	8.6	15	46
比較例	12	エタノール	7	11	18	52
	13	1-プロパノール	0.8	2.3	6.5	11

[0045] (They are the examples 14 and 15 of a comparison to example 9 list) In the examples 7 and 8 of a comparison, it operated by the maximum output consistency by ordinary temperature for continuation 24 hours in the example 3 list, and the water solution of a fuel electrode was analyzed by the gas chroma TOKURA fee. Consequently, when isopropyl alcohol (example 9) was used for a fuel, the acetone was detected as an electrolysis product with isopropyl alcohol. Moreover, in the case of the methanol (example 14 of a comparison), a formic acid, formaldehyde, and methyl formate were detected as a product. In the case of ethanol (example 15 of a comparison), the acetic acid was detected.

[0046] (They are the examples 16 and 17 of a comparison to an example 10 and 11 lists) The current-potential curve same in example 3 list as the examples 7-9 of a comparison was measured except having heated to the temperature which shows an anode in Table 4 in the examples 7-9 of a comparison at example 3 list. A measurement result is shown in Table 4.

[0047]

[Table 4]

		燃料	アノード加熱温度 50℃		アノード加熱温度 70℃	
			開路電圧 (V)	最大出力 (mW)	開路電圧 (V)	最大出力 (mW)
実施例	10	イソプロパノール	0.86	30	0.86	35
	11	エタノール	0.71	41	0.71	61
比較例	16	エタノール	0.68	45	0.68	65
	17	1-プロパノール	0.53	13	0.53	21

[0048] (They are the examples 18 and 19 of a comparison to an example 12 and 13 lists) The current-potential curve same in example 2 list as the examples 4-6 of a comparison was measured except having changed the presentation (element ratio) of a platinum ruthenium alloy, as the examples 4-6 of a comparison were shown in Table 5 at example 2 list, and having heated the anode at 50 degrees C. A measurement result is shown in Table 5.

[0049]

[Table 5]

		燃料	0.7Vにおける電流密度 (mA/cm ²)			
			アノード加熱温度 50℃			
			Pt:Ru=20:80	Pt:Ru=50:50	Pt:Ru=35:65	Pt:Ru=0:100
実施例	12	477 Q ₂ ' 8783- ₂	10.2	15	23	0.5
	13	191- ₂	2.5	6.4	4	0.6
比較例	18	191- ₂	2.4	8.9	3.1	0.4
	19	1-7 Q ₂ ' 1- ₂	0.6	1.7	1.8	0.4

[0050] (They are the examples 20 and 21 of a comparison to an example 14 and 15 lists) The current-potential curve same in example 2 list as the examples 4-6 of a comparison was measured except having changed the presentation (element ratio) of a platinum ruthenium alloy, as the examples 4-6 of a comparison were shown in Table 6 at example 2 list, and having heated the anode at 100 degrees C. A measurement result is shown in Table 6.

[0051]

[Table 6]

		燃料	0.7Vにおける電流密度 (mA/cm ²)			
			アノード加熱温度 100℃			
			Pt:Ru=20:80	Pt:Ru=50:50	Pt:Ru=35:65	Pt:Ru=0:100
実施例	14	477 Q ₂ ' 8783- ₂	27	33	55	1.1
	15	191- ₂	15	46	25	1.2
比較例	20	191- ₂	15	52	23	0.8
	21	1-7 Q ₂ ' 1- ₂	5.3	11	14	1

[0052]

[Effect of the Invention] According to the direct alcoholic mold fuel cell of this invention, the electromotive force and output characteristics exceeding a direct methanol mold fuel cell can be obtained. Moreover, an environmental load becomes [the toxicity of the excretions produced as a result of oxidation reaction] low small.

[Translation done.]